Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Closed Captioning Requirements	)	ET Docket No. 99-254
for Digital Television Receivers	)	
To: The Commission		

COMMENTS OF THE
CONSUMER ELECTRONICS MANUFACTURERS ASSOCIATION

Of Counsel:
David A. Nall
Benigno E. Bartolome
Squire, Sanders & Dempsey L.L.P.
1201 Pennsylvania Avenue, N.W.
Post Office Box 407
Washington, D.C. 20044
(202) 626-6600

Gary S. Klein
Vice President,
Government and Legal Affairs

Michael Petricone
Director, Technology Policy
Government and Legal Affairs

Ralph Justus
Acting Vice President
Technology & Standards

2500 Wilson Boulevard
Arlington, Virginia 22201
(703) 907-7600

October 18, 1999

SUMMARY

In this proceeding, the Commission proposes to amend Part 15 of its rules to adopt technical standards for the display of closed captions on digital television ("DTV") receivers. As set forth more fully in the comments that follow, CEMA supports the promotion and standardization of closed captioning technology. CEMA recognizes that while closed captioning will continue to play a critical role in expanding the availability of programming to the hearing impaired, the potential benefits of closed captioning technology extend beyond the disabled community to virtually every television viewer. CEMA believes that there exists a market incentive for manufacturers to create DTV receivers with closed captioning capabilities and to enhance those capabilities through the benefits of digital technology. Accordingly, the Commission need adopt only those proposals that are necessary to ensure the availability of closed captioning on DTV receivers and to effect the statutory purpose of the TDCA.

Specifically, CEMA agrees with the Commission's proposal to require DTV receivers to function pursuant to recommendations for the operation of DTV closed captioning decoders contained in Section 9 of EIA-708-A, but urges the Commission to adopt the more current version of Section 9 that appears in EIA-708-B. Further, CEMA believes that the Commission should mandate only those technical standards contained in EIA-708-B that are necessary to ensure the availability of closed captioning in DTV receivers. Manufacturers should be permitted to determine the appropriateness of implementing additional closed captioning features contained in EIA-708-B.

It is also CEMA's position that the TDCA's requirement that closed caption decoder circuitry be included in all television receivers with picture screens 13 inches or greater in size should be applied to DTV receivers based on height, not screen area or diagonal measurement as

applied to analog receivers. This is necessary because of the screen shape differential between a DTV receiver and an analog receiver. While CEMA agrees that during the transition period, it is important that closed captioning display capability be available in both digital and analog mode, the Commission should allow manufacturers to determine how the captioned text on digital television receivers should be displayed. Further, the Commission must ensure that manufacturers are not required to produce DTV sets that must display any and all enhancements made possible through digital technologies. CEMA believes that manufacturers must have the flexibility to phase in such enhancements based on technical, marketing and cost considerations, and not to be constrained by regulatory mandates regardless of these factors. This flexibility is necessary at least until an all-digital environment is achieved.

In the NPRM, the Commission tentatively concludes that 47 U.S.C. § 330(b) provides the Commission with authority to require closed captioning capability in converter boxes and tuners. CEMA, however, is not convinced that the Commission has such authority under the TDCA. CEMA points out that neither the statutory language of Section 330(b) nor its accompanying legislative history state that set-top boxes and DTV tuner components are included in the range of "apparatus" required to display closed captioning. Finally, the Commission should delay the effective date of its closed captioning rules to provide for the completion of testing and chip design relevant to the EIA standard, *i.e.*, for a minimum of three years after adoption. A consensus on a test stream that will provide a basis for uniform design and evaluation has yet to be reached. Further, the chip software and interface design for EIA-708 has yet to be finalized and tested. CEMA urges the Commission to adopt rules for the provision of closed captioning on DTV receivers consistent with CEMA's comments in this proceeding.

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To: The Commission

COMMENTS OF THE
CONSUMER ELECTRONICS MANUFACTURERS ASSOCIATION

The Consumer Electronics Manufacturers Association ("CEMA"), pursuant to Section

1.415 of the Commission's Rules, 47 C.F.R. § 1.415, hereby respectfully submits its comments

in response to the Notice of Proposed Rulemaking ("NPRM") issued by the Commission in the

above-captioned proceeding.[1]

I.   INTRODUCTION AND STATEMENT OF INTEREST

In the NPRM, the Commission proposes to amend Part 15 of its rules to adopt technical

standards for the display of closed captions on digital television ("DTV") receivers. The

Commission also proposes to require the inclusion of closed captioning decoder circuitry in DTV

receivers. The Commission states that its actions in this proceeding will help ensure access to

digital programming for people with disabilities and fulfill its obligations under the Television

Decoder Circuitry Act of 1990 ("TDCA").[2]

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[1]   *In the Matter of Closed Captioning Requirements for Digital Television Receivers*, ET
Docket No. 99-254, Notice of Proposed Rule Making, FCC 99-180 (rel. July 15, 1999)
("NPRM"), 64 Fed. Reg. 41897 (Aug. 2, 1999).

[2]   Pub. L. No. 101-431, 104 Stat. 960 (1990) (codified at 47 U.S.C. §§ 303(u), 330(b)). The
TDCA requires that television receivers with picture screens 33 centimeters (13 inches)

CEMA, a sector of the Electronics Industries Alliance, is the principal trade association of the consumer electronics industry. CEMA members design, manufacture, distribute and sell a wide variety of consumer electronics equipment, including televisions, radios, computers, videocassette recorders, and tape and compact disc players. CEMA has consistently sought to promote dialogue and develop consensus on the numerous policy and technical issues associated with assistive television services in order to facilitate the smoothest possible implementation of these technologies. As the Commission is well aware, CEMA has led efforts to establish standards for closed captioning for television receivers (both analog and digital).

In 1991, CEMA's Television Data Systems Subcommittee ("TDSS") presented the Commission with a standard developed by television receiver manufacturers and caption service providers. The document defined the digital data format to be inserted in line 21, field 1 of the vertical blanking interval so that television receiver manufacturers would be able to design the closed captioning decoder chips required by law. The work of the TDSS formed the basis for the Commission's rules which specify the technical standards for the reception and display of closed captioning.[3] The TDSS subsequently developed, with the encouragement of the Commission, specifications to enhance closed captioning and related services through use of line 21, field 2.[4]

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or larger contain built-in decoder circuitry designed to display closed caption television transmissions. In 1991, the FCC amended its rules to include standards for the display of closed captioned text on analog television receivers. By adopting the NPRM, the Commission seeks to ensure that closed captioning services are available on digital television receivers.

[3]   *See* 47 C.F.R. § 15.119.

[4]   *See Amendment of Part 15 of the Commission's Rules to Implement the Provisions of the Television Decoder Circuitry Act of 1990*, 6 FCC Rcd 2420, 2431 (1992) (subsequent history omitted).

In response to a CEMA petition for rulemaking, the Commission authorized the optional transmission of enhanced captioning on line 21, field 2 in 1993.[5]

CEMA's TDSS is generally recognized as the premier repository of expertise regarding the technical issues surrounding the reception and display of closed captioning, and has been requested by the Advanced Television Systems Committee ("ATSC") to develop a closed captioning standard for the ATSC Advanced Television standard. Since then, as the Commission announced in the NPRM, the Electronics Industries Alliance has developed a standard which provides guidelines for caption providers as well as encoder and decoder manufacturers to implement closed captioning services with digital television technology. As the Commission has proposed, this standard will be used by digital television manufacturers for guidance in designing captioning-capable receivers.

As set forth more fully below, CEMA supports the promotion and standardization of closed captioning technology, but urges the Commission to adopt only those proposals that are necessary to ensure the availability of closed captioning on digital television receivers and to effect the statutory purpose of the Television Decoder Circuitry Act of 1990. Beyond that, the Commission should defer to the judgment of manufacturers to determine what additional standards should be implemented.

CEMA recognizes that while closed captioning will continue to play a critical role in expanding the availability of programming to the hearing impaired, the potential benefits of

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[5] *See Amendment of the Rules Relating to Permissible Uses of the Vertical Blanking Interval of Broadcast Television Signals*, 8 FCC Rcd 3613 (1993). The efforts mentioned in this paragraph were undertaken by EIA's Consumer Electronics Group, as CEMA was formerly known.

closed captioning extend beyond the disabled community to virtually every television viewer.[6]

Indeed, the large numbers of individuals with hearing disabilities and those who find closed

captioning to be a convenient feature create a considerable market demand for receivers with

closed captioning capabilities. There is thus a market incentive for manufactures to create DTV

receivers with closed captioning capabilities and to enhance those capabilities through the

benefits of digital technology. Accordingly, CEMA believes that any regulatory burden on

manufacturers need only be minimal.

II. DTV RECEIVERS SHOULD BE REQUIRED TO FUNCTION PURSUANT TO RECOMMENDATIONS CONTAINED IN SECTION 9 OF EIA-708-B, NOT EIA-708-A.

In the NPRM, the Commission proposes to require DTV receivers to function pursuant to

recommendations contained in Section 9 of EIA-708-A.[7] Section 9 contains recommendations

for the operation of DTV closed captioning decoders. The recommendations are intended to

provide minimum performance standards for DTV caption decoders. Because Section 9 supplies

manufacturers with a set of common basic functions for DTV caption decoders, the Commission

believes that it provides sufficient guidance for the successful implementation of closed caption

services with digital television receivers. The Commission thus proposes to transcribe the

recommendations contained in Section 9 into requirements that will be contained in Part 15 of

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[6]   CEMA recognizes that closed captioning can offer other benefits. As the Commission
has found, closed captioning can be an effective tool in teaching literacy skills for young
children as well as adults who are functionally illiterate. It also serves as a useful
learning aid for the approximately 3-4 million Americans learning English as a second
language. Additionally, closed captioning provides a convenient feature for all viewers –
closed captioning can be activated when the mute button on the television receiver is
depressed or when noise levels in the viewing environment impede normal hearing (*e.g.*,
in airports terminals, hotel lobbies, restaurants, bars, and waiting rooms). *See In the
Matter of Closed Captioning and Video Description of Video Programming*, MM Docket
No. 95-176, Notice of Inquiry, 11 FCC Rcd 4912, 4918-19 (1995).

[7]   *See NPRM* at ¶¶ 5-7.

the Commission's Rules, and require DTV receivers to function pursuant to recommendations contained therein. CEMA agrees with the Commission's proposal to require DTV receivers to function pursuant to recommendations contained in Section 9, but urges the Commission to adopt the more current version of Section 9 that appears in EIA-708-B, a copy of which is attached to these comments as Appendix A.

In the NPRM, the Commission also asks whether there are more caption features, in addition to those contained in Section 9, that should be required for DTV receivers.[8] It is CEMA's position that the Commission should mandate only those technical standards (contained in Section 9 of EIA-708-B) that are necessary to ensure the availability of closed captioning in DTV receivers. The recommendations in Section 9 provide manufacturers sufficient guidance for the successful implementation of closed caption services with digital television receivers. Thus, CEMA urges the Commission to allow manufacturers to determine the appropriateness of implementing additional closed captioning features contained in EIA-708-B.

III. THE TDCA'S REQUIREMENT THAT CLOSED CAPTION DECODER CIRCUITRY BE INCLUDED IN ALL TELEVISION RECEIVERS WITH PICTURE SCEENS 13 INCHES OR GREATER IN SIZE SHOULD BE APPLIED TO DTV RECEIVERS BASED ON HEIGHT, NOT SCREEN AREA OR DIAGONAL MEASUREMENT AS APPLIED TO ANALOG RECEIVERS.

In the NPRM, the Commission proposes to require all DTV receivers with picture screens "13 inches or greater in size" to include closed caption decoder circuitry that functions pursuant to recommendations contained in Section 9 of the proposed EIA standard.[9] The Commission invites comment as to whether this standard is appropriate when applied to DTV receivers. CEMA believes that the "13 inches or greater" standard is not appropriate for DTV receivers.

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[8]   *Id.* at ¶ 8.

[9]   *Id.* at ¶¶ 9-10.

CEMA recommends that equivalent height measurement instead, not diagonal or screen area, should be used as the basis for imposing the TDCA requirement.

As the Commission recognizes, "because digital television picture screens will be shaped differently from analog picture screens, based on the FTC labeling requirements, similarly labeled DTV receivers and analog receivers may actually have overall picture areas of different sizes."[10] Whereas current analog receivers have a screen size ratio of 4:3, resulting in a relatively square screen, most digital receivers will have a ratio of 16:9, resulting in a more rectangular shape. Therefore, an analog receiver marketed with a picture screen measuring "13 inches diagonal" will have a picture area of 81.12 square inches; on the other hand, a DTV receiver labeled "13 inches diagonal" will have a picture area of 72.18 square inches. That is a significant difference in total picture area.

If the 13 inches or greater standard applied to analog receivers is applied to DTV receivers, the shorter relative vertical size on the DTV receiver (as the size comparison above illustrates) will cause the display of closed captioned text to take up significant vertical space on the screen, interfering with the picture, or to be significantly smaller than was intended in the original 13" diagonal requirements. This would not be an acceptable result to the television viewer. Moreover, it must be noted that a large percentage of programming received during the transition period will be analog, with closed captioning text that will be formatted pursuant to EIA-608 for analog 4:3 screens and will not "stretch out" along the longer horizontal axis of DTV display units. Accordingly, in order to compensate for the screen shape differential, while still complying with the objectives of the TDCA, CEMA recommends that closed captioning should be required for DTV receivers that are 7.8 inches or greater in height. CEMA believes

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[10]   *Id.* at 9.

that this measurement is sufficient to capture the captioned text while not significantly

interfering with the picture, and it is comparable to a 13 inch, diagonally measured, analog

receiver with a screen size ratio of 4:3.[11]

IV. **WHILE DUAL MODE DTV RECEIVERS SHOULD BE ABLE TO DISPLAY CLOSED CAPTIONED TEXT IN EITHER ANALOG OR DIGITAL MODE, MANUFACTURERS SHOULD BE ALLOWED TO DETERMINE HOW THE CAPTIONED TEXT ON DIGITAL TELEVISION RECEIVERS SHOULD BE DISPLAYED.**

In the NPRM, the Commission seeks to ensure that closed captioning display capability is

available in both analog and digital modes of operation, in recognition that during the transition

period from analog to digital broadcasting, programming will be transmitted in both analog and

digital formats and that the first few generations of DTV receivers are expected to be designed to

operate in dual mode.[12] Accordingly, the Commission proposes to require that dual mode

receivers operating in the analog mode provide closed captioning functionality pursuant to the

Commission's existing rules for analog television receivers. In the digital mode, such receivers

will be required to function in accordance with the EIA standard (as stated earlier, CEMA

recommends EIA-708-B, not EIA-708-A).

CEMA agrees with the observation at paragraph 12 of the NPRM that, during the

transition period, it is important that closed captioning display capability be available in both

modes of operation. CEMA notes with concern, however, the Commission's tentative proposal

to require that "the decoder circuitry in digital tuners respond primarily to <u>any</u> digitally formatted

caption information."[13] While this proposal may be construed to be in conflict with the proposal

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[11] A 4:3 ratio with 7.8" height equates to a 16" diagonal with a 16:9 ratio at the same height.

[12] *See NPRM* at ¶ 11.

[13] *Id.* (emphasis added).

made at paragraph 7 of the NPRM to incorporate only the provisions of Section 9 of the EIA standard into the Commission's rules, CEMA believes that the intent of this proposal is to ensure that the baseline digital closed captioning information received by digital circuitry conforming to Section 9 will be readily accessible to users. CEMA does not interpret this proposal as one that would require manufacturers to produce DTV sets that must display any and all enhancements made possible through digital technologies and would oppose any such proposal as unwarranted. Manufacturers must have the flexibility to phase in such enhancements based on technical, marketing and cost considerations, and not to be constrained by regulatory mandates regardless of these factors.

CEMA believes that this flexibility is necessary at least until an all-digital environment is achieved. This request for flexibility is consistent with what Congress anticipated with respect to evolving technologies. The Senate Report that accompanied the TDCA states: "The Committee expects that, in developing display standards, the FCC will pay due regard to considerations of cost-effectiveness and evolving technical capability, as well as the benefits to the competitive process of allowing manufacturers latitude consistent with the purposes of this bill."[14] CEMA notes that this request for flexibility is not intended to frustrate the Commission's objectives here. The Commission can be assured that manufacturers will have every incentive to design their receivers that will best meet consumer needs.

Moreover, CEMA believes that during the transition from analog to digital broadcasting, viewers should have discretion to decide whether the captioned text on digital television receivers is displayed in analog or digital format. This flexibility is important during the transition period because, for example, if the consumer has a 4:3 display screen but has a tuner

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[14]   S. Rep. No. 101-393, at 9 (1990), *reprinted in* 1990 U.S.C.C.A.N. 1438, 1446.

capable of receiving the captions for a 16:9 display, then the presentation of the captioned text transmitted for the wide-screen display will be unintelligible unless the consumer has the option to change the display default.

V. CONTRARY TO THE COMMISSION'S INTERPRETATION, SECTION 330(b) OF THE COMMUNICATIONS ACT DOES NOT PROVIDE THE COMMISSION AUTHORITY TO REQUIRE CLOSED CAPTIONING CAPABILITY IN SET-TOP DTV CONVERTER BOXES, DTV TUNERS, AND OTHER SIMILAR DEVICES.

The Commission anticipates that, during the transition period, many consumers will purchase set-top DTV converter boxes that allow digitally transmitted television signals to be displayed on analog receivers. The Commission further anticipates that some manufacturers may choose to sell DTV tuners and display units separately. Accordingly, in the NPRM, the Commission proposes to require that all such devices be subject to the provisions of the Television Decoder Circuitry Act of 1990 and thus provide for the display of closed captioning.[15]

Specifically, the Commission proposes to require that DTV converter boxes used with analog receivers either decode any analog caption information that is transmitted with the DTV signal or pass this information directly to the receiver in a form recognizable by the receiver's built-in caption decoder. Further, the Commission proposes that separately sold DTV tuners will be required to have the capability to respond to digitally encoded caption information. The Commission states that "[a]lthough these converter boxes and tuners may be marketed without display screens, we tentatively conclude that 47 U.S.C. § 330(b) provides the Commission with authority to require closed captioning capability in these devices."[16]

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[15] *See NPRM* at ¶ 12.

[16] *Id.*

CEMA is not unsympathetic to the Commission's desire to ensure that closed captioning

capabilities are widely disseminated to the viewing public. CEMA questions, however, whether

the Commission has the wide-ranging authority to require closed captioning capability in all

devices capable of receiving DTV transmissions. Section 330(b) of the Communications Act

states:

> No person shall ship in interstate commerce, manufacture, assemble, or import from any
> foreign country into the United States, any apparatus described in section 303(u) of this
> Act except in accordance with rules prescribed by the Commission pursuant to the
> authority granted by that section. Such rules shall provide performance and display
> standards for such built-in decoder circuitry. Such rules shall further require that all such
> apparatus be able to receive and display closed captioning which have been transmitted
> by way of line 21 of the vertical blanking interval . . . . As new video technology is
> developed, the Commission shall take such action as the Commission determines
> appropriate to ensure that closed-captioning service continues to be available to
> consumers. This subsection shall not apply to carriers transporting such apparatus
> without trading it.[17]

This provision, which was added to the Communications Act by the Television Decoder

Circuitry Act of 1990, plainly does not specify set-top box converters and DTV tuner

components in the range of "apparatus" required to display closed captioning. Further, a reading

of this subsection reflects that when Congress required that "all such apparatus be able to receive

and display closed captioning," it did not specifically contemplate inclusion of equipment

separate from receivers and equipment (e.g., set-top boxes, VCRs, DTV tuners, etc.) that are not

capable of "display[ing]," by itself, closed captioned text.

A review of the legislative history that accompanied Section 330(b) also does not

support the Commission's asserted authority. The relevant Senate Report indicates that

Congress intended, by this subsection, to eliminate the need of consumers (in particular deaf and

hard-of-hearing people) to purchase a separate decoder device in order to receive closed-

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[17]   47 U.S.C. § 330(b).

captioning service on their television receivers.[18] Congress recognized that although these units existed, many deaf and hard-of-hearing people still were without closed captioned service on their television units because of cost, stigma, and "intimidation due to both the technology and difficulty in installing separate decoders."[19] Thus, Congress proposed that all new television sets 13 inches or greater in size be capable of receiving closed-captioned programming. There was clearly no reference to requiring separate equipment, such as set-top boxes and tuners, from also being equipped with the capability to provide closed captioning. Statements in the legislative history to the TDCA reflect specific application of closed captioning requirement only to television sets. Below are sample statements supporting this conclusion.

> "After holding hearings on this bill, the Committee believes there is a compelling need to require that *most new television sets* sold in the United States have built-in decoder circuitry."[20] (emphasis added).

> "S. 1974 does not mandate a specific decoding technology to be installed *in television sets*."[21] (emphasis added).

> "This section amends section 330 of the Act by adding a new subsection (b) which requires the FCC to establish performance and display standards to ensure that the circuitry used to provide closed captioning *in television sets* complies with the FCC's existing rules . . . . "[22] (emphasis added).

Further, although the language of Section 330(b) requires the Commission to take "such actions as the Commission determines appropriate to ensure that closed-captioning service

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[18] S. Rep. No. 101-393, at 3, *reprinted in* 1990 U.S.C.C.A.N. at 1440.

[19] *Id.*

[20] S. Rep. No. 101-393, at 5, *reprinted in* 1990 U.S.C.C.A.N. at 1442.

[21] S. Rep. No. 101-393, at 6, *reprinted in* 1990 U.S.C.C.A.N. at 1443.

[22] S. Rep. No. 101-393, at 9, *reprinted in* 1990 U.S.C.C.A.N. at 1446.

continues to be available to consumers" "[a]s new technology develops," CEMA believes that

Congress was referring to the anticipated introduction of advanced television receivers, not the

ability of separate equipment to facilitate close captioning service through the existing analog

receiver base.

Given the foregoing, CEMA asks that the Commission reconsider its tentative conclusion

concerning its authority to require all set-top boxes, DTV tuners, and other such devices to

provide for the display of closed captioning. Even though it takes a more limited view of the

Commission's authority, CEMA concedes that the statutory purpose should not be defeated

simply because DTV tuner and display functionalities are provided to viewers in separate

components. CEMA would thus not object to a rule that would require manufacturers to include

DTV closed captioning capability in non-display-capable tuners designed to operate with

monitors with a display screen that is 7.8 inches in height or larger. With respect to set-top

devices designed to convert DTV transmissions for display by analog receivers, CEMA would

also not object to a rule that requires that such devices receive "digitized" closed captioning

information formatted pursuant to EIA-608 and the current version of Section 15.119 of the

Commission's rules and decode this for purposes of compatibility with an analog closed

captioning decoder.[23] The converter should also not interfere with the resident closed captioning

capabilities of analog receivers. CEMA would object, however, to any requirement that digital-

to-analog converters must have the capability to decode any DTV closed captioning

transmissions for analog display, including those that did not include digitized analog closed

captioning information. Such a requirement, while appropriate for digital television sets, is not

appropriate under the statute for equipment that may be used with analog receivers of any size

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[23]   Indeed, some DTV receivers today already have this capability.

and for which the sole purpose is to extend the useful lifetime of such analog receivers. The Commission should also not establish closed captioning requirements for other non-display equipment capable of receiving DTV transmissions, such as VCRs. The Commission can be assured that the lack of such requirements will not serve to deter manufacturers from widely implementing closed captioning capabilities with digital television technology, given the market demand.

VI. THE COMMISSION SHOULD DELAY THE EFFECTIVE DATE OF ITS CLOSED CAPTIONING RULES TO PROVIDE FOR THE COMPLETION OF TESTING AND CHIP DESIGN RELEVANT TO THE EIA STANDARD, *I.E.*, FOR A MINIMUM OF THREE YEARS AFTER ADOPTION.

The Commission, in paragraph 14 of the NPRM, tentatively proposes that its rule changes become effective one year after adoption. While a laudable goal, CEMA is convinced that this timetable is far too ambitious for manufacturers to meet. CEMA contends that one year after adoption of an order in this proceeding is simply not sufficient for manufacturers to comply with closed captioning requirements and ensure the production of a product satisfactory to consumers. Evaluations and testing are ongoing and will continue after closed captioning rules for DTV are finalized. A final consensus on a "test stream" that will provide a basis for uniform design and evaluation of receivers' compliance with EIA-708 has yet to be reached. The Commission should also consider design and production schedules in order to provide for a smooth transition for product introduction.

Further, the chip software and interface design for EIA-708 has yet to be finalized and tested. CEMA believes it would be detrimental to consumer confidence if forced compression of standards testing and manufacturer design schedules resulted in the release of an unsatisfactory product. Given these concerns, CEMA urges the Commission to provide manufacturers at least

three years after adoption to complete any tests and evaluations before the rules become effective.

VII.   CONCLUSION

For the reasons stated in the foregoing, CEMA urges the Commission to adopt rules for the provision of closed captioning on DTV receivers consistent with the comments expressed by CEMA herein.

Respectfully submitted,

**Consumer Electronics
Manufacturers Association**

By: _Gary Klein / BEB_

Gary S. Klein
Vice President,
Government and Legal Affairs

Of Counsel:
David A. Nall
Benigno E. Bartolome
Squire, Sanders & Dempsey L.L.P.
1201 Pennsylvania Avenue, N.W.
Post Office Box 407
Washington, D.C. 20044
(202) 626-6600

Michael Petricone
Director, Technology Policy
Government and Legal Affairs

Ralph Justus
Acting Vice President
Technology & Standards

2500 Wilson Boulevard
Arlington, Virginia 22201
(703) 907-7600

October 18, 1999

Digital Television (DTV) Closed Captioning

EIA-708-B, Section 9

9 DTVCC Decoder Manufacturer Recommendations

The following are the recommendations for DTV Closed Captioning decoder implementation including DTV, SDTVand HDTV. These recommendations are directed to the least common denominator of all of the DTVCC features described in the previous sections. Although voluntary, these recommendations should be considered as requirements for a realistic minimal implementation of the DTVCC capabilities. These minimal recommendations provide a bridge from NTSC (ANSI/EIA-608) captioning implementation to the eventual full-feature implementation of this DTVCC specification .

It should be emphasized that these minimum recommendations are not intended to, and should not, restrict caption providers from using the whole suite of DTVCC commands and their extensive capabilities. The following sections address the minimum recommendations that have been anticipated, but may not cover all conditions and manifestations. It is up to the manufacturer to consider all situations that are not explicitly presented herein.

> NOTE--The section numbers in the following headings refer to the corresponding sections in the current DTVCC Specification, EIA-708-B, to which the minimum recommendations apply.

9.1 DTVCC Section 4.2 - Pre-Allocated Bandwidth

While the DTVCC Caption Channel provides a continuous 9600 bps bit stream within the DTVCC Transport Channel, the individual bandwidth allocated to any single service shall not exceed 25% of the total bandwidth averaged over any 1 second time interval. This limit permits a maximum, average captioning data rate of 300 Bps per service.

That is, decoders need only implement enough buffering and processing power to handle a maximum of 2400 bps for each service. In effect, when this limit is exceeded for a service, the input storage buffer allocated for the service will overflow and data not already buffered will be lost.

> NOTE-- In contrast, the per-service limitation addressed above still provides a five-fold enhancement over the maximum possible NTSC Closed-Caption service data rate of 60 Bps.

9.2 DTVCC Section 6.1 - Services

Decoders should be capable of decoding and processing data for at least one (1) service. Decoders shall be capable of decoding and processing the Caption Service Directory data.

9.3 DTVCC Section 6.2 - Caption Channel Service Blocks

Decoders should be capable of decoding all Caption Channel Block Headers consisting of Standard Service Headers, Extended Service Block Headers, and Null Block headers. However, decoding of the data is required only for Standard Service Blocks (Service IDs <= 6), and then only if the characters for the corresponding language are supported.

Decoders should be able to display the directory for services 1 through 6. Service decoding and directory display for services numbered 7 or greater are optional.

9.4 DTVCC Section 7.1 - Code Space Organization

Decoders must support Code Space C0, G0, C1, and G1 in their entirety.

The following characters within code space G2 must be supported:

- transparent space ($_{TSP}$)
- non-breaking transparent space ($_{NBTSP}$)
- solid block (█)
- trademark symbol (™)
- Latin-1 characters (Š, Œ, š, œ, Ÿ)

The substitutions in Table 17~~Table 17~~ are to be made if a decoder does not support the remaining G2 characters.

G2 Character	Substitute With
open single quote ('), G2 char code 0x31	G0 single quote ('), char code 0x27
close single quote('), G2 char code 0x32	G0 single quote ('), char code 0x27
open double quote ("), G2 char code 0x33	G0 double quote ("), char code 0x22
close double quote ("), G2 char code 0x34	G0 double quote ("), char code 0x22
bold bullet (•), G2 char code 0x35	G1 bullet (·), char code 0xB7
ellipsis(...), G2 char code 0x25	G0 underscore (_), char code 0x5F
one-eighth ($^1/_8$), G2 char code 0x76	G0 percent sign (%), char code 0x25
three-eighths ($^3/_8$), G2 char code 0x77	G0 percent sign (%), char code 0x25
five-eighths ($^5/_8$), G2 char code 0x78	G0 percent sign (%), char code 0x25
seven-eighths ($^7/_8$), G2 char code 0x79	G0 percent sign (%), char code 0x25
vertical border (	), G2 char code 0x7A	G0 stroke (|), char code 0x7C
upper-right border ( ), G2 char code 0x7B	G0 dash (-), char code 0x2D
lower-left border (L), G2 char code 0x7C	G0 dash (-), char code 0x2D
horizontal border (—), G2 char code 0x7D	G0 dash (-), char code 0x2D
lower-right border ( ), G2 char code 0x7E	G0 dash (-), char code 0x2D
upper-left border (⌐), G2 char code 0x7F	G0 dash (-), char code 0x2D

Table 17 G2 Character Substitution Table

Support for code spaces C2, C3, and G3 is optional.

All unsupported graphic symbols in the G3 code space are to be substituted with the G0 underscore character (_), char code 0x5F.

9.5 DTVCC Section 8.2 - Screen Coordinates
Table 18 specifies the screen coordinate resolutions and limits for anchor point positioning in 4:3 and 16:9 display formats, and the number of characters per row.

Screen Aspect Ratio	Maximum Anchor Position Resolution	Minimum Anchor Position Resolution	Maximum Displayed Rows	Maximum Characters per Row
4:3	75v x 160h	15v x 32h	4	32
16:9	75v x 210h	15v x 42h	4	42
other	75v x (5 x H)	15v x H*	4	*

Table 18 Screen Coordinate Resolutions & Limits

*H = 32 x (the width of the screen in relation to a 4:3 display). For example, the 16:9 format is 1/3 wider than a 4:3 display; thus, H = 32 * 4/3 = 42.667, or 42.

This means that the minimum grid resolution for a 4:3 aspect ratio instrument is 15 vertical positions x 32 horizontal positions. This minimum grid resolution for 16:9 ratio instrument is 15 vertical positions x 42 horizontal positions. These minimum grid sizes are to cover the entire safe-title area of the corresponding screen.

The minimum coordinates equate to a 1/5 reduction in the maximum horizontal and vertical grid resolution coordinates. Caption providers are to use the maximum coordinate system values when specifying anchor point positions. Decoders using the minimum resolution are to divide the provided horizontal and vertical screen coordinates by 5 to derive the equivalent minimum coordinates.

Any caption targeted for both 4:3 and 16:9 instruments is limited to 32 contiguous characters per row. If a caption is received by a 4:3 instrument that is targeted for a 16:9 display only, or requires a window width greater than 32

characters, then the caption may be completely disregarded by the decoder. 16:9 instruments should be able to process and display captions intended for 4:3 displays, providing all other minimum recommendations are met.

If the resulting size of any window is larger than the safe title area for the corresponding display's aspect ratio, then this window will be completely disregarded.

9.6 DTVCC Section 8.4 - Caption Windows

Decoders need to display no more than 4 rows of captions on the screen at any given time, regardless of the number of windows displayed. This implies that no more than 4 windows can be displayed at any given time (with each having only one caption row).

However, decoders should maintain storage to support a minimum total of 8 rows of captions. This storage is needed for the worst-case support of a displayed window with 4 rows of captioning and a non-displayed window which is buffering the incoming rows for the next 4-row caption.

As implied above, the maximum number of windows that may be displayed at any one time by a minimum decoder implementation is 4. If more than 4 windows are defined in the caption stream, the decoder may disregard the youngest and lowest priority window definition(s). Caption providers must be aware of this limitation, and either restrict the total number of windows used or accept that some windows will not be displayed.

9.7 DTVCC Section 8.4.2 - Window Priority

Decoders do not need to support overlapped windows. If a window overlaps another window, the overlapped window need not be displayed by the decoder. Decoders may support overlapped windows as an option.

9.8 DTVCC Section 8.4.6 - Window Size

At a minimum, decoders will assume that all windows have rows and columns "locked". This implies that if a decoder implements the optional SMALL pen-size, then word-"un"wrapping, when shrinking captions, need not be implemented. Also, if a decoder implements the optional LARGE pen size, then word wrapping (when enlarging captions) need not be implemented.

9.9 DTVCC Section 8.4.8 - Word Wrapping

Decoders may support word wrapping as an option.

9.10 DTVCC Section 8.4.9 - Window Text Painting

9.10.1 Justification

All decoders should implement "left", "right", and "center" caption-text justification. Implementation of "full" justification is optional. . If "full" justification is not implemented, fully justified captions should be treated as though they are "left" justified.

For "left" justification, decoders should display any portion of a received row of text when it is received. For "center", "right", and "full" justification, decoders may display any portion of a received row of text when it is received, or may delay display of a received row of text until reception of a row completion indicator. A row completion indicator is defined as receipt of a CR, ETX or any other command , except SetPenColor, SetPenAttributes, or SetPenLocation where the pen relocation is within the same row.

Receipt of a character for a displayed row which already contains text with "center", "right" or "full" justification will cause the row to be cleared prior to the display of the newly received character and any subsequent characters. Receipt of a justification command which changes the last received justification for a given window will cause the window to be cleared.

9.10.2 Print Direction

At a minimum, decoders must support LEFT_TO_RIGHT printing.

9.10.3 Scroll Direction

At a minimum, decoders must support BOTTOM_TO_TOP scrolling.

For windows sharing the same horizontal scan lines on the display, scrolling may be disabled.

9.10.4 Scroll Rate

At a minimum, decoders must support the same recommended practices for scroll rate as is provided for NTSC closed-captioning.

9.10.5 Smooth Scrolling

At a minimum, decoders must support the same recommended practices for smooth scrolling as is provided for NTSC closed-captioning.

9.10.6 Display Effects

At a minimum, decoders must implement the "snap" window display effect. If the window "fade" and "wipe" effects are not implemented, then the decoder will "snap" all windows when they are to be displayed, and the "effect speed" parameter is ignored.

9.11 DTVCC Section 8.4.11 - Window Colors and Borders

At a minimum, decoders need only to implement borderless windows with solid, black backgrounds (i.e., border type = NONE, fill color = (0,0,0), fill opacity = SOLID), and borderless transparent windows (i.e., border type = NONE, fill opacity = TRANSPARENT).

9.12 DTVCC Section 8.4.12 - Predefined Window and Pen Styles

Predefined Window Style and Pen Style ID's may be provided in the DefineWindow command. At a minimum, decoders should implement Predefined Window Attribute Style 1 and Predefined Pen Attribute Style 1, as shown in Table 19Table 19 and Table 20Table 20.

Style ID #	Justify	Print Direction	Scroll Direction	Word Wrap	Display Effect	Effect Direction	Effect Speed	Fill Color	Fill Opacity	Border Type	Border Color	Usage
1	LEFT	LEFT -TO- RIGHT	BOTTOM -TO- TOP	NO	SNAP	n/a	n/a	(0,0,0) Black	SOLID	NONE	n/a	*NTSC Style PopUp Captions*
2	LEFT	LEFT -TO- RIGHT	BOTTOM -TO- TOP	NO	SNAP	n/a	n/a	n/a	TRANS- PARENT	NONE	n/a	*PopUp Captions w/o Black Background*
3	CNTR	LEFT -TO- RIGHT	BOTTOM -TO- TOP	NO	SNAP	n/a	n/a	(0,0,0) Black	SOLID	NONE	n/a	*NTSC Style Centered PopUp Captions*
4	LEFT	LEFT -TO- RIGHT	BOTTOM- TO- TOP	YES	SNAP	n/a	n/a	(0,0,0) Black	SOLID	NONE	n/a	*NTSC Style RollUp Captions*
5	LEFT	LEFT -TO- RIGHT	BOTTOM- TO- TOP	YES	SNAP	n/a	n/a	n/a	TRANS- PARENT	NONE	n/a	*RollUp Captions w/o Black Background*
6	CNTR	LEFT -TO- RIGHT	BOTTOM- TO- TOP	YES	SNAP	n/a	n/a	(0,0,0) Black	SOLID	NONE	n/a	*NTSC Style Centered RollUp Captions*
7	LEFT	TOP -TO- BOTTOM	RIGHT -TO- LEFT	NO	SNAP	n/a	n/a	(0,0,0) Black	SOLID	NONE	n/a	*Ticker Tape*

Table 1919 Predefined Window Style ID's

Predefined Style ID	Pen Size	Font Style	Offset	Italics	Underline	Edge Type	Foregrnd Color	Foregrnd Opacity	Backgrnd Color	Backgrnd Opacity	Edge Color	Usage
1	STNDR	0	NORMAL	NO	NO	NONE	(2,2,2) White	SOLID	(0,0,0) Black	SOLID	n/a	*Default NTSC Style**
2	STNDR	1	NORMAL	NO	NO	NONE	(2,2,2) White	SOLID	(0,0,0) Black	SOLID	n/a	*NTSC Style* Mono w/ Serif*
3	STNDR	2	NORMAL	NO	NO	NONE	(2,2,2) White	SOLID	(0,0,0) Black	SOLID	n/a	*NTSC Style* Prop w/ Serif*
4	STNDR	3	NORMAL	NO	NO	NONE	(2,2,2) White	SOLID	(0,0,0) Black	SOLID	n/a	*NTSC Style* Mono w/o Serif*
5	STNDR	4	NORMAL	NO	NO	NONE	(2,2,2) White	SOLID	(0,0,0) Black	SOLID	n/a	*NTSC Style* Prop w/o Serif*
6	STNDR	3	NORMAL	NO	NO	UNIFRM	(2,2,2) White	SOLID	n/a	TRANS-PARENT	(0,0,0) Black	*Mono w/o Serif, Bordered Text, No BG*
7	STNDR	4	NORMAL	NO	NO	UNIFRM	(2,2,2) White	SOLID	n/a	TRANS-PARENT	(0,0,0) Black	*Prop. w/o Serif, Bordered Text, No BG*

Table 2020 Predefined Pen Style ID's

* "NTSC Style" - White Text on Black Background

9.13 DTVCC Section 8.5.1 - Pen Size

At a minimum, decoders must support the STANDARD pen size, with the implementation of the LARGE and SMALL pen sizes being optional.

The STANDARD pen size should be implemented such that the height of the tallest character in any implemented font is no taller than 1/15 of the height of the safe-title area, and the width of the widest character is no wider than 1/32 of the width of the safe-title area for 4:3 displays and 1/42 of the safe-title area width for 16:9 displays.

The LARGE pen size should be implemented such that the width of the widest character in any implemented font is no wider than 1/32 of the safe-title area for 16:9 displays. This recommendation allows for captions to grow to a LARGE pen size without having to reformat the caption since no caption will have more than 32 characters per row (see Section 8.4.6).

9.14 DTVCC Section 8.5.3 - Font Styles

Although a caption service provider may specify any one of 8 font styles using the **SetPenAttributes** command, decoders need only to implement a single font for caption text display.

Decoders that implement more than one font but do not support a font style specified in the **SetPenAttributes** command should instead display the caption text in the most similar font available. In decoders with only one font (i.e., font style 0, the default), all caption text, regardless of the specified font style, will be displayed in the default font.

In decoders with more than one but less than eight fonts, unsupported font styles should be displayed using an alternate font, giving precedence to the spacing attribute of the indicated font style, if possible. For example, if the specified but unsupported font style is "monospaced with serifs", the best substitute would be another monospaced font, and the second-best alternative would be a proportionally spaced font with serifs. If the Cursive font style is not supported, an acceptable substitution is an italicized version of an available font.

All supported font styles may be implemented in any typeface which the decoder manufacturer deems to be a readable rendition of the font style, and need not be in the exact typefaces given as examples in Section 8.5.3.

9.15 DTVCC Section 8.5.4 - Character Offsetting

Decoders need not to implement the character offsetting (i.e., subscript and superscript) pen attributes.

9.16 DTVCC Section 8.5.5 - Pen Styles

At a minimum, decoders must implement normal, italic, and underline pen styles.

9.17 DTVCC Section 8.5.6 - Foreground Color and Opacity

At a minimum, decoders must implement solid and flashing character foreground type attributes.

At a minimum, decoders must implement the following character foreground colors: white, black, red, green, blue, yellow, magenta and cyan.

9.18 DTVCC Section 8.5.7 - Background Color and Opacity

Decoders need only implement solid black character backgrounds. It is recommended that this background is extended beyond the character foreground to a degree that the foreground is separated from the underlying video by a sufficient number of background pixels to insure the foreground is separated from the background.

9.19 DTVCC Section 8.5.8 - Character Edges

Decoders need not to implement separate character edge color, opacity, and type attribute control. In this case, there is no separately controlled edge surrounding the body of characters.

9.20 DTVCC Section 8.8 - Color Representation

At a minimum, decoders must support the 8 colors described in Table 21 ~~Table 21~~.

Color	Red	Green	Blue
Black	0	0	0
White	2	2	2
Red	2	0	0
Green	0	2	0
Blue	0	0	2
Yellow	2	2	0
Magenta	2	0	2
Cyan	0	2	2

Table 212+ Minimum Color List Table

When a decoder supporting this Minimum Color List receives an RGB value not in the list, it will map the received value to one of the values in the list via the following algorithm:

- All one (1) values are to be changed to 0
- All two (2) values are to remain unchanged
- All three (3) values are to be changed to 2

For example, the RGB value (1,2,3) will be mapped to (0,2,2), (3,3,3) will be mapped to (2,2,2) and (1,1,1) will be mapped to (0,0,0).

Table 22~~Table 22~~ is an alternative minimum color list table supporting 22 colors.

Color	Red	Green	Blue
Black	0	0	0
Gray	1	1	1
White	2	2	2
Bright White	3	3	3
Dark Red	1	0	0
Red	2	0	0
Bright Red	3	0	0
Dark Green	0	1	0
Green	0	2	0
Bright Green	0	3	0
Dark Blue	0	0	1
Blue	0	0	2
Bright Blue	0	0	3
Dark Yellow	1	1	0
Yellow	2	2	0
Bright Yellow	3	3	0
Dark Magenta	1	0	1
Magenta	2	0	2
Bright Magenta	3	0	3
Dark Cyan	0	1	1
Cyan	0	2	2
Bright Cyan	0	3	3

Table 22~~22~~ Alternative Minimum Color List Table

When a decoder supporting the Alternative Minimum Color List in Table 22~~Table 22~~ receives an RGB value not in the list (i.e., an RGB value whose non-zero elements are not the same value), it will map the received value to one of the values in the list via the following algorithm:

- For RGB values with all elements non-zero and different - e.g., (1,2,3), (3,2,1), and (2,1,3), the 1 value will be changed to 0, the 2 value will remain unchanged, and the 3 value will be changed to 2.
- For RGB values with all elements non-zero and with two common elements - e.g. (3,1,3), (2,1,2), and (2,2,3), if the common elements are 3 and the uncommon one is 1, then the 1 elements is changed to 0; e.g. (3,1,3) -> (3,0,3). If the common elements are 1 and the uncommon element is 3, then the 1 elements are changed to 0, and the 3 element is changed to 2; e.g. (1,3,1) -> (0,2,0). In all other cases, the uncommon element is changed to the common value; e.g., (2,2,3) -> (2,2,2), (1,2,1) -> (1,1,1), and (3,2,3) -> (3,3,3).

All decoders not supporting either one of the two color lists described above, must support the full 64 possible RGB color value combinations.

9.21 Character Rendition Considerations

In NTSC Closed Captioning, decoders were required to insert leading and trailing spaces on each caption row. There were two reasons for this requirement:

1. to provide a buffer so that the first and last characters of a caption row do not fall outside the safe title area, and

2. to provide a black border on each side of a character so that the "white" leading pixels of the first character on a row and the trailing "white" pixels of the last character on a row do not bleed into the underlying video.

Since caption windows are required to reside in the safe title area of the DTV screen, reason number 1 (above) is not applicable to DTVCC captions.

The attributes available in the **SetPenAttributes** command for character rendition (e.g.,character background and edge attributes) provide unlimited flexibilty to the caption provider when describing caption text in an ideal decoder implementation. However, manufacturers need only implement a minimum of pen attributes and font styles. Thus it is recommended that no matter what the level of implementation, decoder manufacturers should take into account the readablility of all caption text against a variety of all video backgrounds, and should implement some automatic character delineation when the individual control of character foreground, background and edge is not supported; and when only a minimum number of font styles are implemented.

9.22 DTVCC Section 8.9 - Service Synchronization
Service Input Buffers must be at least 128 bytes in size. Caption providers must keep this lower limit in mind when following Delay commands with other commands and window text. In other words, no more than 128 bytes of DTVCC commands and text should be transmitted (encoded) before a pending Delay command's delay interval expires.

9.23 DTV to NTSC Transcoders
It is anticipated that receiver (decoder) manufacturers will develop devices (e.g., settop boxes) which process an DTV stream and transcode it for display on NTSC monitors. The DTVCC command set is not necessarily transcodable to NTSC captions; i.e., there are DTVCC captions which have no NTSC equivalent.

Although receiver manufacturers are free to attempt an automatic transcode of the captions, there is no guarantee that the captions will appear as the caption provider intended. Caption providers apply many techniques to make the captions easy to read and as unobtrusive as possible over the underlying video. To maintain caption quality during an automated transcode process, a set of conversion rules would have to be defined which cover all possible window, pen and text attribute combinations.

Therefore, a separate NTSC caption channel was added to the Picture User Data (see Section 4.3). This channel allows caption providers to encode dual caption streams within the same programming. NTSC captions are under the complete control of the caption provider; and thus, no automated transcoding of captions is necessary.